

## Claim

I claim:

1 1. A method for forming a mosaic image on a display surface with a plurality of  
2 projectors, comprising:  
3 projecting, for each projector in turn, a registration image onto the display  
4 surface so that a union of the projected registration images forms a polygon;  
5 acquiring with a camera, for each registration image in turn, a corresponding  
6 input image;  
7 identifying a display area on the display surface enclosed by the polygon;  
8 determining, for each projector, a single projective matrix between the  
9 display area and each input image;  
10 warping, for each projector, a source image according to the corresponding  
11 single projective matrix;  
12 weighting pixels of the warped source image according to the single  
13 projective matrix; and  
14 concurrently projecting the warped and weighted source images directly  
15 onto the display surface to form the mosaic image.

1 2. The method of claim 1 wherein the display surface is oblique to an optical axis  
2 of at least one of the projectors.

1 3. The method of claim 1 wherein an optical axis of one projector is oblique to an  
2 optical axis of at least one other projector.

1 4. The method of claim 1 wherein an optical axis of each projector is oblique an  
2 optical axis of every other projector.

1 5. The method of claim 1 wherein the registration image includes a checkerboard  
2 pattern.

1 6. The method of claim 1 wherein the display area is a largest rectangle enclosed  
2 by the polygon.

1 7. The method of claim 1 further comprising:

2 defining, for each projector, a first homography between the camera and the  
3 projector;

4 defining, for each projector, a second homography between the display area  
5 and the camera; and

6 combining the first and second homographies to form the single projective  
7 matrix.

1 8. The method of claim 7 wherein the first homography  $\mathbf{H}$  is a maximum  
2 likelihood estimation problem, and further comprising:

3 minimizing cost function

4 
$$\sum^n \|\mathbf{u} - \mathbf{H}\mathbf{x}\|,$$

5 where  $n$  indicates a number of corresponding features between the input image  $\mathbf{x}$ ,  
6 and the registration image  $\mathbf{u}$ .

1 9. The method of claim 8 wherein a mapping of pixels between two arbitrary  
2 source images is

$$3 \quad \mathbf{u}_j \sim \mathbf{H}_j \mathbf{H}_i^{-1} \mathbf{u}_i,$$

4 where  $\mathbf{u}_i$  and  $\mathbf{u}_j$  denote corresponding pixels in the source images, and  $\mathbf{H}$  is the  
5 second homography.

1 10. The method of claim 1 further comprising:

2 assigning a zero weight to a particular pixel in each warped image if the  
3 particular pixel is outside the display area;

4 assigning a one weight to the particular pixel if the particular pixel is an only  
5 pixel illuminating the display area; and otherwise

6 assigning a weight  $W$  in a range  $0 < W < 1$  to the particular pixel, where  $W$   
7 is proportional to a distance to a nearest pixel having a zero weight.

1 11. A system for forming a mosaic image on a display surface, comprising:

2 a plurality of projectors, each projector arranged to project a registration  
3 image onto the display surface so that a union of the projected registration images  
4 forms a polygon;

5 a camera arranged to acquiring, for each registration image in turn, a  
6 corresponding input image;

7 means for identifying a display area on the display surface enclosed by the  
8 polygon;

9 means for determining, for each projector, a single projective matrix  
10 between the display area and each input image;

11 means for warping, for each projector, a source image according to the  
12 corresponding single projective matrix;

13 means for weighting pixels of each warped source image according to the  
14 single projective matrix so that projected warped and weighted source images form  
15 the mosaic image on the display surface.

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